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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/044,468
Filing Date: January 11, 2002
Appellant(s): SHARMA ET AL.

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AUG 0 8 2007

Technology Center 2600

Patrick Floyd
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 21 May 2007 appealing from the Office action mailed 16 August 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2002/0024548 A1	GOTOH ET AL	2-2002
6,014,500	WANG	1-2000
5,880,857	SHIAU ET AL	3-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-3, 25-26 and 28 are rejected under 35 U.S.C. 102(e) as being anticipated by Gotoh (US Patent Application Publication 2002/0024548 A1).

Regarding claim 1: Gotoh discloses a method of halftoning for multi-pass rendering, wherein different pixel locations are rendered in each pass (para. 69, lines 1-5 of Gotoh), the method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (para. 71, lines 5-9 of Gotoh). In the example given, half of the turned-on pixels are printed in two passes (para. 71, lines 5-9 of Gotoh). Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

Regarding claim 2: Gotoh discloses that the substantial majority is approximately 75% or more of the pixels turned on to render a tone (para. 71, lines 5-9 of Gotoh). As discussed in the arguments regarding claim 1, three-quarters (75%) of the turned-on pixels are restricted from being printed.

Regarding claim 3: Gotoh discloses that the substantial majority is approximately 90% or more of the pixels turned on to render a tone (para. 72, lines 5-9 and para. 73, lines 4-9 of Gotoh). In the case of 64 nozzles, only 1.5625% of the turned-on pixels are printed with a single nozzle. Thus, more than 90% of the turned-on pixels are restricted from being printed so that, with two sets of 32 nozzles (para. 73, lines 4-9 of Gotoh), a tone can be rendered in the minimum number of passes.

Regarding claim 25: Gotoh discloses a method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (para. 71, lines 5-9 of Gotoh). In the example given, half of the turned-on pixels are printed in two passes (para.

71, lines 5-9 of Gotoh). Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

Regarding claim 26: Gotoh discloses generating a screen pixel turn-on sequence (figure 26 and para. 79-80 of Gotoh); and partitioning the turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh) corresponding to rendering passes (para. 72, lines 4-7 and para. 81 of Gotoh), wherein the restricting step includes re-ordering the pixel turn-on sequence (para. 80 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

Regarding claim 28: Gotoh discloses a system (figure 16 and para. 49 of Gotoh) comprising means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (para. 71, lines 5-9 of Gotoh). In the example given, half of the turned-on pixels are printed in two passes (para. 71, lines 5-9 of Gotoh). Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

Claims 4-10, 27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US Patent Application Publication 2002/0024548 A1) in view of Wang (US Patent 6,014,500).

Regarding claim 4: Gotoh discloses generating a screen pixel turn-on sequence (figure 26 and para. 79-80 of Gotoh); and partitioning the screen pixel turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh), wherein each partition corresponds to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh).

Gotoh does not disclose expressly that said screen pixel turn on sequence is specifically a stochastic screen pixel turn on sequence.

Wang discloses generating a stochastic screen pixel turn-on sequence (column 5, lines 52-56 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence, as taught by Wang. The suggestion for doing so would have been that stochastic screens provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 4.

Regarding claim 5: Gotoh discloses re-ordering the screen pixel turn-on sequence (para. 80 of Gotoh) to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (figure 21C and para. 71, lines 5-9 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 6: Gotoh discloses generating a halftone screen (figure 26 of Gotoh) using the re-ordered screen pixel turn-on sequence (para. 79-80 of Gotoh). The gray scale patterns (figure 26 of Gotoh) are clearly halftone screens since they are used to determine which dots are printed for a corresponding gray level value.

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 7: Gotoh does not disclose expressly that the re-ordering step including placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition.

Wang discloses placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition (column 7, lines 30-40 of Wang). The stochastic screen pixel turn-on sequence values are partitioned into checkerboard and reverse-checkerboard partitions (column 7, lines 30-40 of Wang). Since first half (S_1) turn-on sequence is in checkerboard form, then the first partition must be the lowest stochastic screen pixel turn-on sequence values and the second half (S_2) must be the highest stochastic screen pixel turn-on sequence values.

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence in the partitioning order taught by Wang. The suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 7.

Regarding claim 8: Gotoh discloses that a checkerboard pattern is used for printing the individual pixels of the first partition, and then a reverse checkerboard pattern is used for printing the individual pixels of the second partition (figure 21C and para. 72, lines 9-19 of Gotoh).

Gotoh does not disclose expressly (a) replacing the lowest stochastic screen pixel turn-on value before re-ordering contained in one partition with a replacement value which is the lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (b) replacing the next lowest stochastic screen pixel turn-on value in the one partition with a replacement value which is the next lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (c) repeating step (b) until the one partition is filled with the lowest stochastic screen pixel turn-on sequence values of all partitions;

and (d) repeating steps (a) through (c) to re-order each of the other partitions in turn with the remaining unused replacement values.

Wang discloses re-ordering the stochastic screen pixel turn-on values (column 5, lines 52-61 of Wang) to optimize a merit function and thus minimize the level of moiré (column 7, lines 44-55 of Wang) based on a checkerboard pattern (column 7, lines 28-34 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to re-order the stochastic screen pixel turn-on sequence values according to a checkerboard pattern, as taught by Wang, based specifically on the ordering of the checkerboard pattern (partition 1) and inverted checkerboard pattern (partition 2) taught by Gotoh. Since the pattern (figure 21C of Gotoh) prints in an order of alternating dots, the reordering performed according to the teachings of Wang (column 5, lines 52-61 of Wang) would be performed to produce the same pattern (figure 21C of Gotoh; and column 7, lines 28-34 of Wang). Thus, the re- ordering would be performed such that (a) the lowest stochastic screen pixel turn-on value is replaced before re-ordering contained in one partition with a replacement value which is the lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (b) the next lowest stochastic screen pixel turn-on value is replaced in the one partition with a replacement value which is the next lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (c) step (b) is repeated until the one partition is filled with the lowest stochastic screen pixel turn-on sequence values of all partitions; and (d) steps (a) through (c) are repeated to re-order each of the other partitions in turn with the remaining unused replacement values. The motivation for doing so would have been that the optimization taught by Wang eliminates moiré between the input and the screen (column 7, lines 25-30 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 8.

Regarding claim 9: Gotoh discloses that a checkerboard pattern is used for printing the individual pixels of the first partition, and then a reverse checkerboard pattern is used for printing the individual pixels of the second partition (figure 21C and para. 72, lines 9-19 of Gotoh).

Gotoh does not disclose expressly (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence.

Wang discloses re-ordering the stochastic screen pixel turn-on values (column 5, lines 52-61 of Wang) to optimize a merit function and thus minimize the level of moiré (column 7, lines 44-55 of Wang) based on a checkerboard pattern (column 7, lines 28-34 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to re-order the stochastic screen pixel turn-on sequence values according to the order of the checkerboard pattern (partition 1) and inverted checkerboard pattern (partition 2), as taught by Wang, based specifically on the ordering of the checkerboard pattern taught by Gotoh. Since the pattern (figure 21C of Gotoh) prints in a specific order with respect to each partition, the re-ordering performed according to the teachings of Wang (column 5, lines 52-61 of Wang) would be performed to produce the same pattern (figure 21C of Gotoh; and column 7, lines 28-34 of Wang). Thus, the re-ordering would be performed by (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence. The motivation for doing so would have been that the optimization taught by Wang

eliminates moiré between the input and the screen (column 7, lines 25-30 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 9.

Regarding claim 10: Gotoh discloses partitioning the screen pixel turn-on sequence into two partitions (figure 26 (8B,8C) and para. 79-80 of Gotoh).

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 27: Gotoh does not disclose expressly that the step of generating a pixel turn-on sequence includes optimizing a merit function representative of the halftone texture quality.

Wang discloses optimizing a merit function representative of the halftone texture quality (column 7, lines 44-49 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use and optimize the specific merit function taught by Wang. The suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 27.

Regarding claim 29: Gotoh discloses a screen pixel turn-on sequence generator (figure 26 and para. 79-80 of Gotoh); and means for partitioning the screen pixel turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh) each partition corresponding to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh), wherein the restricting means includes means for re-ordering the screen pixel turn-on sequence (para. 80 of Gotoh) to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone

(figure 21C and para. 71, lines 5-9 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

Gotoh does not disclose expressly that said screen pixel turn on sequence is specifically a stochastic screen pixel turn on sequence.

Wang discloses generating a stochastic screen pixel turn-on sequence (column 5, lines 52-56 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence, as taught by Wang. The suggestion for doing so would have been that stochastic screens provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 29.

Claims 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US Patent Application Publication 2002/0024548 A1) in view of Wang (US Patent 6,014,500) and obvious engineering design choice.

Regarding claim 11: Gotoh does not disclose expressly that the partitions are designated S_1 and S_2 and the merit function is $\widetilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where $M(S)$ is a merit function suitable for a single stochastic screen and w_1 and w_2 are weighting factors in the range of 2 to approximately 100.

Wang discloses that the partitions are designated S_1 and S_2 and the merit function is $\widetilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where $M(S)$ is a merit function suitable for a single stochastic screen (column 7, lines 42-53 of Wang) and w_1 and w_2 are weighting factors (column 7, lines 54-55 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the specific merit function taught by Wang. The suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh.

Gotoh in view of Wang does not disclose expressly that the weighting factors are in the range of 2 to approximately 100. However, it would have been an obvious engineering design choice to set the weighting factors in the range of 2 to approximately 100. Firstly, the weighting factors are set for the purpose of balancing the overall quality and moiré removal (column 7, lines 54-55 of Wang). Secondly, the exact weighting values depend, at least in part, on how the function $M(S)$ is specifically defined. Setting the weighting values to 3 or 0.3 or 0.0003 or 300000 (for example) depends upon factors such as how the density values are expressed, the range of the density values, and the physical units applied when using the equation to obtain a specific result. Thus, setting the weighting values would simply be an operation that one of ordinary skill in the art at the time of the invention would perform for the purpose of practicing the system set forth by Gotoh in view of Wang. Therefore, it would have been obvious to implement the obvious engineering design choice in the system of Gotoh in view of Wang to obtain the invention as specified in claim 11.

Further regarding claim 12: Wang discloses that the partitioning step includes partitioning into a checkerboard partition arrangement (column 7, lines 25-30 of Wang).

Further regarding claim 13: Wang discloses generating a halftone screen for a checkerboard partition (column 7, lines 25-30 of Wang) such that the pixels can be classified as belonging to the two partitions using the coordinates of columns and rows, i and j, and the mathematical rule $p(i,j) \in S_1, if(i,j)\%2 = 0$; $p(i,j) \in S_2, if(i,j)\%2 = 1$; $S = S_1 + S_2$ (column 7, lines 30-41 of Wang) and optimizing the merit function $\widetilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where w_1 and w_2 are weighting factors (column 7, lines 44-55 of Wang).

As discussed above in the arguments regarding claim 11, it would have been an obvious design choice to set w_1 and w_2 in the range of 2 to approximately 100.

Regarding claim 14: Gotoh in view of Wang does not disclose expressly that $w_1 \approx 3$ and $w_2 \approx 3$. However, it would have been an obvious engineering design choice to set the weighting factors such that $w_1 \approx 3$ and $w_2 \approx 3$. Firstly, the weighting factors are set for the purpose of balancing the overall quality and moiré removal (column 7, lines 54-55 of Wang). Secondly, the exact weighting values depend, at least in part, on how the function $M(S)$ is specifically defined. Setting the weighting values to 3 or 0.3 or 0.0003 or 300000 (for example) depends upon factors such as how the density values are expressed, the range of the density values, and the physical units applied when using the equation to obtain a specific result. Thus, setting the weighting values would simply be an operation that one of ordinary skill in the art at the time of the invention would perform for the purpose of practicing the system set forth by Gotoh in view of Wang. Therefore, it would have been obvious to implement the obvious engineering design choice in the system of Gotoh in view of Wang to obtain the invention as specified in claim 14.

Claims 15-24 and 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US Patent Application Publication 2002/0024548 A1) in view of Shiau (US Patent 5,880,857).

Regarding claim 15: Gotoh discloses providing an input image having a plurality of pixels each having an input tone value (para. 61, lines 7-10 of Gotoh); and partitioning the input image pixels into partitions (figure 21C; figure 26(8B, 8C); and para. 80 of Gotoh) wherein each partition corresponds to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh).

Gotoh does not disclose expressly adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value; and comparing the desired pixel value with a threshold value, wherein the restricting step includes adding a zero mean bias signal to the input tone value based on the partition containing the input image pixel.

Shiau discloses adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau), wherein the restricting step includes adding a zero mean bias signal to the input tone value based on the partition containing the input image pixel (column 3, lines 62-66 and column 5, lines 11-19 of Shiau). Since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau).

Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 15.

Regarding claim 20: Gotoh discloses providing an input image having a plurality of pixels each having an input tone value (para. 61, lines 7-10 of Gotoh); and partitioning the input image pixels into partitions (figure 21C; figure 26(8B, 8C); and para. 80 of Gotoh) wherein each partition corresponds to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh).

Gotoh does not disclose expressly adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value; and comparing the desired pixel value with a threshold value, wherein the restricting step includes adding a zero mean bias signal to the threshold value based on the partition containing the input image pixel.

Shiau discloses adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau), wherein the restricting step includes adding a zero mean bias signal to the threshold value (column 3, lines 62-66 and column 4, lines 30-34 of Shiau) based on the partition containing the input image pixel (column 5, lines 11-19 of Shiau). Since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau).

Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 20.

Regarding claims 16 and 21: Gotoh discloses partitioning the input image pixels into two partitions (figure 26(8B,8C) and para. 79-80 of Gotoh).

Regarding claims 17-18 and 22-23: Gotoh discloses partitioning the input image pixels into a checkerboard partition (figure 21 and para. 72, lines 9-13 of Gotoh).

Gotoh does not disclose expressly that the zero mean bias signal has a value of +D for one partition and –D for the other partition.

Shiau discloses that the zero mean bias signal has a value of +D (e.g. +20) for a first section of input data and –D (e.g. –20) for a second section of input data (column 8, lines 15-25 of Shiau).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a bias of +D for one partition and a bias of –D for another partition, as taught by Shiau. The motivation for doing so would have been to be able to properly apply the correct amount of perturbing noise (column 8, lines 50-55 of Shiau), thus helping to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claims 17-18 and 22-23.

Further regarding claims 19 and 24: Shiau discloses that the input image tone value can be one of 256 values (0 to 255) (column 7, lines 25-29 of Shiau) and the value of D is between approximately 32 and 64 (column 5, lines 15-26 of Shiau). For the case of a grey value of 85, the coefficient is 0.5. There-fore, for a random noise value of plus or minus 128, the value of D is 64, and for a random noise value of plus or minus 64, the value of D is 32.

Regarding claim 30: Gotoh discloses means for partitioning an input image having a plurality of input pixel tone values (para. 61, lines 7-10 of Gotoh) into a plurality of partitioned pixel tone values (figure 21C; figure 26(8B,8C); and para. 79-80 of Gotoh).

Gotoh does not disclose expressly means for processing the partitioned pixel tone values to produce a previously processed pixel error diffusion value; means for processing a current partitioned input pixel tone value including means for adding the previously processed pixel error diffusion value to the current partitioned input pixel tone value to achieve a desired pixel value; and means for comparing the desired pixel value with a threshold value to produce an output signal for rendering the image, wherein the means for restricting includes means for adding a zero mean bias signal being based on the partition containing the partitioned pixel tone value.

Shiau discloses means for processing pixel tone values to produce a previously processed pixel error diffusion value (column 4, lines 18-20 of Shiau); means for processing a current input pixel tone value including means for adding the previously processed pixel error diffusion value to the current input pixel tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and means for comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau) to produce an output signal for rendering the image (column 4, lines 12-18 of Shiau), wherein the means for restricting includes means for adding a zero mean bias signal being based on the partition containing the partitioned pixel tone value (column 3, lines 62-66 and column 5, lines 11-19 of Shiau). Since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random

values with a zero mean bias, as taught by Shiau, to the partitions taught by Gotoh. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 30.

Regarding claim 31: Gotoh discloses means for partitioning an input image having a plurality of input pixel tone values (para. 61, lines 7-10 of Gotoh) into a plurality of partitioned pixel tone values (figure 21C; figure 26(8B,8C); and para. 79-80 of Gotoh).

Gotoh does not disclose expressly means for processing the partitioned pixel tone values to produce a previously processed pixel error diffusion value; means for processing a partitioned input pixel tone value including means for adding the previously processed pixel error diffusion value to the partitioned input pixel tone value to achieve a desired pixel value; and means for comparing the desired pixel value with a threshold value to produce an output signal for rendering the image, wherein the means for restricting includes means for adding a zero mean bias signal to the threshold value, the zero mean bias signal being based on the partition containing the partitioned pixel tone value.

Shiau discloses means for processing pixel tone values to produce a previously processed pixel error diffusion value (column 4, lines 18-20 of Shiau); means for processing an input pixel tone value including means for adding the previously processed pixel error diffusion value to the input pixel tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and means for comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau) to produce an output signal for rendering the image (column 4, lines 12-18 of Shiau), wherein the means for restricting includes means for adding a zero mean bias signal to the threshold value (column 3, lines 62-66 and column 4, lines 30-34 of Shiau), the zero mean bias function being based on the partition containing the partitioned pixel tone value (column 5, lines 11-19 of Shiau). Since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then

multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau, to the partitions taught by Gotoh. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 31.

(10) Response to Argument

Regarding Section A.1 [see page 8, line 20 to page 11, line 4 of Appeal Brief]:

Firstly, Appellant is attempting to incorporate limitations from the specification into the claims, which is inappropriate [see MPEP §2111.01 (II)]. Claim 1 specifically recites a "method of halftoning for multi-pass rendering, wherein different pixel locations are rendered in each pass, the method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone". The recited language "render a tone to the minimum number of passes required to produce the tone" is very broad language. The interpretation of the claim language is not limited merely to the specific examples presented by Appellant from the specification, nor is the interpretation limited to Appellant's particular interpretation presented in the present Appeal Brief. The "minimum number of passes required to produce the tone" would be based on how a particular multi-pass rendering device operates.

In Gotoh (US Patent Application Publication 2002/0024548 A1), multi-pass printing is performed using a "checkerboard" pattern and "inverse checkerboard" pattern [see, *e.g.*, figure 21A of Gotoh which is referenced in para. 69, lines 1-5 of Gotoh, cited in Office action of 16 August 2006]. In an example shown in figure 21A of Gotoh, a 25% tone level is rendered by printing one-quarter of the overall number of positions. This is performed in one pass, namely the "checkerboard pattern" pass. So, in a two-pass system designed according to the teachings of Gotoh, one pass is needed to print a 25% tone level, one pass being the minimum number of passes required to produce the tone. Further, by printing a 25% tone level in one pass, the system of Gotoh restricts a substantial majority of the pixels turned on to render a tone. Specifically, 75% of the pixels are restricted, the restricted pixels composed of all of the pixels in the "inverted checkerboard" pass and half of the pixels in the "checkerboard" pass.

Further, the portion of the rejection of claim 1 quoted by Appellant [see last paragraph of page 8 of Appeal Brief] is not the entire rejection of claim 1, and was used by Examiner simply to help further explain how the cited portions of Gotoh anticipate the limitations of claim 1 already addressed in the rejection of claim 1.

Regarding Section A.2 [see page 11, lines 6-15 of Appeal Brief]:

As set forth in the rejection of claim 2, Gotoh discloses that the substantial majority is approximately 75% or more of the pixels turned on to render a tone (para. 71, lines 5-9 of Gotoh). As discussed in the arguments regarding claim 1, three-quarters (75%) of the turned-on pixels are restricted from being printed. Thus, the recited language of claim 2 is anticipated by Gotoh.

Regarding Section A.3 [see page 11, lines 17-32 of Appeal Brief]:

If a tone is rendered in only a single pass with a single nozzle, then the maximum tone level is set based on how many nozzles are available. For a single nozzle in a 64 nozzle system designed according

to the teachings of Gotoh, only 1/64-th (or 1.5625%) of the pixels will be printed by that single nozzle. If "a tone" as recited is a tone of 1.5625% or less, then the tone will be rendered in a single pass with a single nozzle of 64 nozzles, which will thus restrict 98.4375% of the pixels from being turned on to render a tone. Again, as with claims 1 and 2, the specifically recited claim language is anticipated by Gotoh, even if Gotoh were to be deemed to not fully teach Appellant's particular interpretation of the claim language, which Appellant has constructed through incorporating the specification into the claims.

Regarding Section A.4 [see page 12, lines 1-19 of Appeal Brief]:

Firstly, "generating a stochastic halftone screen for multi-pass rendering" is a portion of the preamble of the claim. The phrase "generating a stochastic halftone screen" does not substantially relate to the positively recited steps of claim 25. The remaining disputed claim language is the same claim language disputed in Appellant's arguments with respect to claim 1. Thus, Examiner's response above regarding Section A.1 of the Appeal Brief is applicable to Appellant's arguments in the presently addressed Section A.4 of the Appeal Brief. Furthermore, since claim 25 is anticipated by Gotoh, claims 26-27 cannot be considered patentable merely due to their respective dependencies.

Regarding Section A.5 [see page 12, lines 21-30 of Appeal Brief]:

Appellant argues that "[w]hile Gotoh may teach re-ordering a pixel turn-on sequence, Gotoh does not teach restricting a substantial majority of the pixels turned on to render a tone ...".

Examiner replies that Appellant is thus arguing with respect to the disputed limitations of claim 25, from which claim 26 depends. Since claim 25 has been shown to be anticipated by Gotoh, both in the prior art rejections and in Examiner's response to Section A.4 of the Appeal Brief, claim 26 cannot be considered allowable merely due to its dependency.

Regarding Section A.6 [see page 13 of Appeal Brief]:

The recited means of claim 28 is a computational device which instructs a multi-pass printer how to render a particular tone level. An equivalent means is found in Gotoh since Gotoh also uses a computational device to instruct a multi-pass printer how to render a particular tone level. The particularly recited details of how the recited means renders the tone levels is taught by Gotoh since the means recited in claim 28 performs the process recited in claim 1. Claim 1 has been shown to be anticipated, both in the response to Section A.1 of the Appeal Brief given above and in the prior art rejections. Gotoh teaches a computational device instructing a multi-pass printer how to render the tone levels in the manner recited in claims 1 and 28. Thus, claim 28 is anticipated by Gotoh. Also, Examiner notes that claim 28 is also a single means claim, which has been held to be unduly broad [see MPEP §2164.08(a)].

Regarding Section B.1 [see page 14, line 3 to page 15, line 7 of Appeal Brief]:

With respect to page 14, lines 4-11: Appellant's first argument with respect to the limitation "restricting a substantial majority of pixels ...", which is found in claim 1, has been addressed above [see "Regarding Section A.1" above].

With respect to page 14, lines 12-29: Wang (USPN 6,014,500) teaches that the stochastic screen [recited in claim 4, upon which claim 7 depends, and taught in cited column 5, lines 52-56 of Wang] pixel turn-on sequence values are partitioned into checkerboard and reverse-checkerboard partitions [column 7, lines 30-40 of Wang]. In Gotoh, the a checkerboard pattern and reverse-checkerboard pattern are also used in rendering tones, wherein the checkerboard pattern is printed in the first pass for the lowest tone values (and thus with the lowest halftone screen turn-on sequence). Therefore, by combination, since first half (S_1) turn-on sequence is in checkerboard form, then the first partition must be the lowest stochastic

screen pixel turn-on sequence values and the second half (S_2) must be the highest stochastic screen pixel turn-on sequence values.

With respect to page 14, line 30 to page 15, line 7: The full recitation of claim 9 is taught by the combination of Gotoh and Wang, not by Wang separately, as specifically set forth in the 103(a) rejection of claim 9. First, Gotoh teaches that a checkerboard pattern is used for printing the individual pixels of the first partition, and then a reverse checkerboard pattern is used for printing the individual pixels of the second partition [see figure 21C and para. 72, lines 9-19 of Gotoh]. Wang teaches re-ordering the stochastic screen pixel turn-on values, as evidenced by column 5, lines 52-61 of Wang which describes the rearranging of the threshold values of the halftone screen. The rearrangement is performed so as to optimize a merit function and thus minimize the level of moiré [see column 7, lines 44-55 of Wang] based on a checkerboard pattern [see column 7, lines 28-34 of Wang].

The combination of Gotoh in view of Wang therefore would suggest to one of ordinary skill in the art at the time of the invention to re-order the stochastic screen pixel turn-on sequence values according to the order of the checkerboard pattern (partition 1) and inverted checkerboard pattern (partition 2), as taught by Wang, based specifically on the ordering of the checkerboard pattern taught by Gotoh. Since the pattern [figure 21C of Gotoh] prints in a specific order with respect to each partition, the re-ordering performed according to the teachings of Wang [column 5, lines 52-61 of Wang] would be performed to produce the same pattern [figure 21C of Gotoh; and column 7, lines 28-34 of Wang]. Thus, the re-ordering would be performed by (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence. The motivation for such a combination would have been that the optimization taught by Wang eliminates moiré between the input and the screen (column 7, lines 25-30 of Wang).

Regarding Section B.2 [see page 15, lines 9-16 of Appeal Brief]:

Appellant applies the arguments made with respect to claims 1-3 in support of the alleged patentability of claim 29. Thus, Examiner's rebuttals to Applicant's arguments made with respect to claims 1-3 are applied herein with respect to claim 29.

Regarding Section C.1 [see page 15, lines 18-25 of Appeal Brief]:

Appellant argues that claims 11-14 are patentable since claim 1, upon which claims 11-14 depend, is patentable.

Examiner replies that, since claim 1 has been demonstrated to be rendered obvious over the cited prior art, both in the rejections and in the rebuttal set forth above [see "Regarding Section A.1" above] claims 11-14 cannot be considered allowable merely due to their dependencies from claim 1.

Regarding Section D.2 [see page 15, line 27 to page 16, line 18 of Appeal Brief]:

Appellant argues that claims 15-24 are patentable since claim 1, upon which claims 15-24 depend, is patentable.

Examiner replies that, since claim 1 has been demonstrated to be rendered obvious over the cited prior art, both in the rejections and in the rebuttal set forth above [see "Regarding Section A.1" above] claims 15-24 cannot be considered allowable merely due to their dependencies from claim 1.

Appellant argues that Shiau (USPN 5,880,857) does not teach the limitations argued by Examiner in the previous office action since the random noise added by Shiau does not provide a zero mean bias signal to either the input tone value or the threshold value based on the partitioning containing the input image pixel.

Examiner replies that, firstly, claim 15 only recites providing a zero mean bias signal to the input tone value, not the threshold values, based on the partitioning containing the input image pixel. Shiau

teaches adding a zero mean bias signal to the input tone value based on the partition containing the input image pixel [see column 3, lines 62-66 and column 5, lines 11-19 of Shiau]. The cited portion of Shiau discloses this limitation since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level. Thus, the random noise signal has zero mean bias.

In claim 20, there is a limitation which recites providing a zero mean bias signal to either the input tone value or the threshold value based on the partitioning containing the input image pixel. This limitation is also taught by Shiau. Shiau discloses adding a zero mean bias signal to the threshold value [see column 3, lines 62-66 and column 4, lines 30-34 of Shiau] based on the partition containing the input image pixel (column 5, lines 11-19 of Shiau). Again, since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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